Most often we are afraid of things that we can see but we do not understand. However, the threat is not always visible. Water from rivers and lakes seems to be a clear liquid, but there are suspended particles of inorganic minerals or organic compounds that form a suspension. Simply, the water consists of two phases. These two parts of "water" are different in terms of environmental protection and they differently bind substances considered as toxic. Fortunately, it is relatively easy to separate them. Chemical substances polluting water might be of natural or anthropogenic origin (human activities). The presence of chemical compounds such as surfactants, or chemical elements such as thallium and chromium, is the reason for low quality of water. In case of chromium and thallium, their ecotoxicity depends on the chemical form of the element migrating in the ecosystem. Due to large differences in toxicity of various chemical forms of Tl and Cr it is important to monitor not only their total content in the environment, but also their speciation (which chemical compound and how much of it). It has long been known that it is not the chemical element that is "toxic", but its specific chemical or physical form. Both oxidation states of chromium are stable in the aquatic environment. Chromium (III) compounds are less soluble and rather immobile in the environment, while chromium (VI) compounds are more soluble and mobile. Determination of speciation of Tl and Cr is particularly important in case of polluted waters. Changes in the composition of the pollution source or oxygenation of water can change the redox state and the chemical form of these metals. As a consequence there are changes in binding of these forms to suspended matter and in their solubility, which results in their migration or retention.

In this project we state the following hypotheses: it is possible to separate various chemical forms of chromium and thallium from the suspended matter and determine the content of Cr(III), Cr(VI), Tl(I) and Tl(III) in both phases of water (separated by filtration); the surfactants will be degraded using a special lamp imitating sunlight, with no addition of chemical compounds that could change the ratio of both forms of metals; we will propose an electrochemical method of analysis, alternative to commonly used chromatography; the reliability of this new method will be proved by comparison of the results obtained using both methods; we will propose a detailed scheme of the analytical procedure for speciation analysis of Tl and Cr in polluted water – proper way of sampling, sample preparation and the chemical analysis itself.

To achieve our goals we will check different kinds of filtration, after addition of various chemicals to the water samples to prevent any changes in the speciation until the sample is analyzed. We will also check the efficiency of various photocatalysts used for degradation of organic compounds that interfere with the electrochemical measurements. Degradation of these compounds will be done using only irradiation of the sample with light similar to sunlight. In this study two different analytical methods will be used to confirm the correctness of the results. Anodic stripping voltammetry will be used as the main method of analysis, and liquid chromatography with ICP MS or UV-Vis detection will serve as a supporting method. Realization of the project will allow to set up a methodology for speciation analysis, with thoroughly described step of sample preparation, which is crucial for obtaining results corresponding to the initial state of the sample. It is nowadays the greatest challenge for chemists. Also, the results of study on photodegradation using sunlight can be helpful in cleaning of the natural water reservoirs and in developing a cheaper photolysis technology used for drinking water treatment.